

WHAT IS CLAIMED IS:

1. A signal detector to detect data in an input signal, comprising:
  - a finite impulse response (FIR) filter to equalize the data to a primary target;
  - a Viterbi-like detector matched to the primary target and to generate a most likely path corresponding to the data in the input signal;
  - a linear post-processor matched to one of the primary target and a secondary target, and to determine at least one most likely error event in the most likely path, the linear post-processor to generate revised paths based on the at least one most likely error event; and
  - a media noise processor matched to the secondary target and to compute path metrics corresponding to each of the revised paths as a function of a non-linear noise model and to select one of the revised paths based on the path metrics, the secondary target having at least one parameter different than the first target.
2. The signal detector of Claim 1 wherein the FIR filter to communicate the data to the media noise processor.

3. The signal detector of Claim 1 further comprising an analog-to-digital converter (ADC) to communicate the data to the media noise processor.

4. The signal detector of Claim 1 wherein the primary target has a target length and the secondary target has a target length that is greater than the target length of the primary target.

5. The signal detector of Claim 1 wherein the media noise processor further comprises an estimation block to estimate an equalized channel response.

6. The signal detector of Claim 5 wherein the estimation block to estimate non-linear parameters.

7. The signal detector of Claim 5 wherein the estimation block to initialize a secondary target response with a primary target response of the Viterbi-like detector, and to include a least mean squares engine to adapt the secondary target.

8. The signal detector of Claim 6 wherein the non-linear parameters are selected from a group consisting of mean shifts, residual noise variance, and noise whitening filtering (NWF).

9. The signal detector of Claim 5 wherein the media noise processor further comprises a linear error signal generator to determine a linear error as a function of convolving an output of the Viterbi-like detector with secondary target taps from the estimation block.

10. The signal detector of Claim 1 wherein the linear post-processor is matched to the secondary target.

11. The signal detector of Claim 1 wherein the linear post-processor to generate revised paths that correspond to each of the at least one most likely error event.

12. The signal detector of Claim 1 further comprising a correction block to correct the most likely path based on the selected one of the revised paths.

13. The signal detector of Claim 12 wherein the correction block evaluates a parity condition of the most likely path and corrects the most likely path based on the selected one of the revised paths and the parity condition.

14. The signal detector of Claim 13 wherein the parity condition has a parity violated state and a parity not violated state; and

wherein a correction threshold is adjusted based on the parity condition such that the correction threshold is set higher for the parity not violated state.

15. The signal detector of Claim 1 wherein the at least one parameter is selected from a group consisting of target length, value of target taps, and quantity of target taps.

16. The signal detector of Claim 1 wherein the Viterbi-like detector is selected from a group consisting of Viterbi detectors, PRML detectors, tree/ trellis detectors, decision feedback detectors and hybrid detectors.

17. The signal detector of Claim 1 included in a receiver to decode a communication signal from a storage device.

18. A signal detector to detect data in an input signal, comprising:

a finite impulse response (FIR) filter to equalize the data to a primary target;

a Viterbi-like detector matched to the primary target and to generate a most likely path corresponding to the data in the input signal;

a channel response estimator to track a secondary target, the secondary target having at least one parameter different than the primary target; and

a linear post-processor matched to one of the primary target and the secondary target and to determine at least one most likely error event in the most likely path, the linear post-processor to generate revised paths based on the at least one most likely error event, the linear post-processor to compute path metrics corresponding to each of the revised paths as a function of the most likely path and the linear response, and to select one of the revised paths based on the path metrics.

19. The signal detector of Claim 18 wherein the FIR filter to communicate the data to the channel response estimator.

20. The signal detector of Claim 18 further comprising an analog-to-digital converter (ADC) to communicate the data to the channel response estimator.

21. The signal detector of Claim 18 wherein the channel response estimator to initialize a secondary target response with a primary target response of the Viterbi-like detector, and to include a least mean squares engine to adapt the secondary target.

22. The signal detector of Claim 18 wherein the linear post-processor further comprises a linear error signal generator to determine a linear error as a function of convolving an output of the Viterbi-like detector with secondary target taps of the channel response estimator.

23. The signal detector of Claim 18 wherein the linear post-processor generates revised paths that correspond to each of the at least one most likely error event.

24. The signal detector of Claim 18 wherein the linear post-processor further comprises a correction block to correct the most likely path based on the selected one of the revised paths.

25. The signal detector of Claim 24 wherein the correction block to evaluate a parity condition of the most likely path and

to correct the most likely path based on the selected one of the revised paths and the parity condition.

26. The signal detector of Claim 25 wherein the parity condition has a parity violated state and a parity not violated state; and

wherein a correction threshold is adjusted based on the parity condition such that the correction threshold is set higher for the parity not violated state.

27. The signal detector of Claim 18 wherein the at least one parameter is selected from a group consisting of target length, value of target taps, and quantity of target taps.

28. The signal detector of Claim 18 wherein the Viterbi-like detector is selected from a group consisting of Viterbi detectors, PRML detectors, tree/trellis detectors, decision feedback detectors and hybrid detectors.

29. The signal detector of Claim 18 wherein the linear post-processor is matched to the secondary target; and

wherein the primary target has a target length and the secondary target has a target length that is greater than the target length of the primary target.

30. The signal detector of Claim 18 included in a receiver to decode a communication signal from a storage device.

31. A signal detector to detect data in an input signal, comprising:

means for filtering to equalize the data to a primary target;

means for detecting matched to the primary target and to generate a most likely path corresponding to the data in the input signal;

means for post-processing matched to one of the primary target and a secondary target, and to determine at least one most likely error event in the most likely path, the means for post-processing to generate revised paths based on the at least one most likely error event; and

means for operating on the data being matched to the secondary target, the means for operating to compute path metrics corresponding to each of the revised paths as a function of a non-linear noise model and to select one of the revised paths based on the path metrics, the secondary target having at least one parameter different than the primary target.



32. The signal detector of Claim 31 wherein the means for filtering to communicate the data to the means for operating.

33. The signal detector of Claim 31 further comprising means for converting data to communicate the data to the means for operating.

34. The signal detector of Claim 31 wherein the primary target has a target length and the secondary target has a target length that is greater than the target length of the primary target.

35. The signal detector of Claim 31 wherein the means for operating further comprises means for estimating an equalized channel response.

36. The signal detector of Claim 35 wherein the means for estimating to estimate non-linear parameters.

37. The signal detector of Claim 35 wherein the means for estimating to initialize a secondary target response with a primary target response of the means for detecting, and to include a least mean square engine to adapt the secondary target.

38. The signal detector of Claim 36 wherein the non-linear parameters are selected from a group consisting of mean shifts, residual noise variance, and noise whitening filtering (NWF).

39. The signal detector of Claim 35 wherein the means for operating further comprises means for determining a linear error as a function of convolving an output of the means for detecting with secondary target taps from the means for estimating.

40. The signal detector of Claim 31 wherein the means for post-processing is matched to the secondary target.

41. The signal detector of Claim 31 wherein the means for post-processing to generate revised paths that correspond to each of the at least one most likely error event.

42. The signal detector of Claim 31 further comprising means for correcting the most likely path based on the selected one of the revised paths.

43. The signal detector of Claim 42 wherein the means for correcting to evaluate a parity condition of the most likely

path and to correct the most likely path based on the selected one of the revised paths and the parity condition.

44. The signal detector of Claim 43 wherein the parity condition has a parity violated state and a parity not violated state; and

wherein a correction threshold is adjusted based on the parity condition such that the correction threshold is set higher for the parity not violated state.

45. The signal detector of Claim 31 wherein the at least one parameter is selected from a group consisting of target length, value of target taps, and quantity of target taps.

46. The signal detector of Claim 31 wherein the means for detecting is selected from a group consisting of Viterbi detectors, PRML detectors, tree/ trellis detectors, decision feedback detectors and hybrid detectors.

47. The signal detector of Claim 31 included in a receiver to decode a communication signal from a storage device.

48. A signal detector to detect data in an input signal, comprising:

means for filtering to equalize the data to a primary target;

means for detecting to generate a most likely path corresponding to the data in the input signal, the detecting means matched to the primary target;

means for estimating to track a secondary target, the secondary target having at least one parameter different than the primary target; and

means for post-processing matched to one of the primary target and the secondary target, to determine at least one most likely error event in the most likely path, and to generate revised paths based on the at least one most likely error event, the means for post-processing to compute path metrics corresponding to each of the revised paths as a function of the most likely path and the linear response, and to select one of the revised paths based on the path metrics.

49. The signal detector of Claim 48 wherein the means for filtering to communicate the data to the channel response estimator.

50. The signal detector of Claim 48 further comprising means for converting analog to digital to communicate the data to the channel response estimator.

51. The signal detector of Claim 48 wherein the means for estimating to initialize a secondary target response with a primary target response of the detecting means and to include a least mean square engine to adapt the secondary target.

52. The signal detector of Claim 48 wherein the means for post-processing further comprises means for signal generating to determine a linear error as a function of convolving an output of the means for detecting with secondary target taps of the means for estimating.

53. The signal detector of Claim 48 wherein the means for post-processing to generate revised paths that correspond to each of the at least one most likely error event.

54. The signal detector of Claim 48 wherein the means for post-processing further comprises means for correcting the most likely path based on the selected one of the revised paths.

55. The signal detector of Claim 54 wherein the means for correcting to evaluate a parity condition of the most likely path and to correct the most likely path based on the selected one of the revised paths and the parity condition.

56. The signal detector of Claim 55 wherein the parity condition has a parity violated state and a parity not violated state; and

wherein a correction threshold is adjusted based on the parity condition such that the correction threshold is set higher for the parity not violated state.

57. The signal detector of Claim 48 wherein the at least one parameter is selected from the group consisting of target length, value of target taps, and quantity of target taps.

58. The signal detector of Claim 48 wherein the means for detecting is selected from a group consisting of Viterbi detectors, PRML detectors, tree/ trellis detectors, decision feedback detectors and hybrid detectors.

59. The signal detector of Claim 48 wherein the means for post-processing is matched to the secondary target; and

wherein the primary target has a target length and the secondary target has a target length greater than the target length of the primary target.

60. The signal detector of Claim 58 included in a receiver to decode a communication signal from a storage device.

61. A computer program to configure a general purpose computer to perform a method for detecting data in an input signal, comprising:

- equalizing the data to a primary target;
- matching a Viterbi-like detector to the primary target;
- using the Viterbi-like detector to detect data in the input signal to generate a most likely path corresponding to the data;
- generating a most likely path corresponding to the data in the input signal;

- matching a linear post-processor to one of the primary target and a secondary target wherein the secondary target has at least one parameter different than the primary target;

- using the linear post-processor to determine at least one most likely error event in the most likely path;

- generating revised paths based on the at least one most likely error event;

- matching a media noise processor to the secondary target;

- using the media noise processor to operate on the data;

- computing path metrics corresponding to each of the revised paths as a function of a non-linear noise model; and

selecting one of the revised paths based on the path metrics.

62. The computer program of Claim 61 further comprising communicating the data to the media noise processor from a finite impulse response (FIR) filter.

63. The computer program of Claim 61 further comprising communicating the data to the media noise processor from an analog-to-digital converter.

64. The computer program of Claim 61 wherein the primary target has a target length and the secondary target has a target length that is greater than the target length of the primary target.

65. The computer program of Claim 61 wherein the operating on the data further comprises estimating an equalized channel response.

66. The computer program of Claim 65 wherein the estimating further includes estimating non-linear parameters.



67. The computer program of Claim 65 wherein the estimating further includes initializing a secondary target response with a primary target response, and adapting the secondary target.

68. The computer program of Claim 66 wherein the non-linear parameters are selected from a group consisting of mean shifts, residual noise variance, and noise whitening filtering (NWF).

69. The computer program of Claim 67 wherein the operating on the data further comprises determining a linear error as a function of convolving the primary target response with secondary target taps of the secondary target response.

70. The computer program of Claim 61 wherein the linear post-processor is matched to the secondary target.

71. The computer program of Claim 61 wherein the computing the metrics further includes generating revised paths that correspond to each of the at least one most likely error event.

72. The computer program of Claim 61 further comprising correcting the most likely path based on the selected one of the revised paths.

73. The computer program of Claim 72 wherein the correcting further includes evaluating a parity condition of the most likely path and correcting the most likely path based on the selected one of the revised paths and the parity condition.

74. The computer program of Claim 73 wherein the parity condition has a parity violated state and a parity not violated state; and

adjusting a correction threshold based on the parity condition such that the correction threshold is set higher for the parity not violated state.

75.. The computer program of Claim 61 wherein the at least one parameter is selected from a group consisting of target length, value of target taps, and quantity of target taps.

76. The computer program of Claim 61 wherein the Viterbi-like detector is selected from a group consisting of Viterbi detectors, PRML detectors, tree/ trellis detectors, decision feedback detectors and hybrid detectors.

77. The computer program of Claim 61 included in a receiver to decode a communication signal from a storage device.

78. A computer program to configure a general purpose computer to perform a method for detecting data in an input signal, comprising:

- equalizing the data to a primary target;
- matching a Viterbi-like detector to the primary target;
- using the Viterbi-like detector to detect data in the input signal;
- generating a most likely path corresponding to the data in the input signal;
- estimating a secondary target, the secondary target having at least one parameter different than the primary target;
- matching a linear post-processor to one of the primary target and the secondary target;
- using the linear post-processor to operate on the data and determine at least one most likely error event in the most likely path;
- generating revised paths based on the at least one most likely error event;

computing path metrics corresponding to each of the revised paths as a function of the most likely path and the linear response; and

selecting one of the revised paths based on the path metrics.

79. The computer program of Claim 78 wherein the using the linear post-processor further includes receiving the data from a finite impulse response (FIR) filter.

80. The computer program of Claim 78 wherein the using the linear post-processor further includes receiving the data from an analog-to-digital converter.

81. The computer program of Claim 78 wherein the estimating further includes initializing and aligning a secondary target response with a primary target response of the Viterbi-like detector; and

adapting the secondary target based on the aligning.

82. The computer program of Claim 81 wherein the using the linear post-processor further comprises convolving an output of the Viterbi-like detector with secondary target taps of the secondary target response to determine a linear error.

83. The computer program of Claim 78 wherein the using the linear post-processor further includes generating revised paths that correspond to each of the at least one most likely error event.

84. The computer program of Claim 78 wherein the using the linear post-processor further comprises correcting the most likely path based on the selected one of the revised paths.

85. The computer program of Claim 74 wherein the correcting further includes evaluating a parity condition of the most likely path; and

correcting the most likely path based on the selected one of the revised paths and the parity condition.

86. The computer program of Claim 85 wherein the parity condition has a parity violated state and a parity not violated state; and

adjusting a correction threshold based on the parity condition such that the correction threshold is set higher for the parity not violated state.

87. The computer program of Claim 78 wherein the at least one parameter is selected from a group consisting of target length, value of the target taps, quantity of target taps.

88. The computer program of Claim 78 wherein the Viterbi-like detector is selected from a group consisting of Viterbi detectors, PRML detectors, tree/ trellis detectors, decision feedback detectors and hybrid detectors.

89. The computer program of Claim 78 wherein the linear post-processor is matched to the secondary target; and

wherein the primary target has a target length and the secondary target has a target length that is greater than the target length of the primary target.

90. The computer program of Claim 88 included in a receiver to decode a communication signal from a storage device.

91. A method for detecting data in an input signal, comprising:

equalizing the data to a primary target;

matching a Viterbi-like detector to the primary target;

using the Viterbi-like detector to detect data in the input signal to generate a most likely path corresponding to the data;

generating a most likely path corresponding to the data in the input signal;

matching a linear post-processor to one of the primary target and a secondary target wherein the secondary target has at least one parameter different than the primary target;

using the linear post-processor to determine at least one most likely error event in the most likely path;

generating revised paths based on the at least one most likely error event;

matching a media noise processor to the secondary target;

using the media noise processor to operate on the data;

computing path metrics corresponding to each of the revised paths as a function of a non-linear noise model; and

selecting one of the revised paths based on the path metrics.

92. The method of Claim 91 further comprising communicating the data to the media noise processor from a finite impulse response (FIR) filter.

93. The method of Claim 91 further comprising communicating the data to the media noise processor from an analog-to-digital converter.

94. The method of Claim 91 wherein the primary target has a target length and the secondary target has a target length that is greater than the target length of the primary target.

95. The method of Claim 91 wherein the operating on the data further comprises estimating an equalized channel response.

96. The method of Claim 95 wherein the estimating further includes estimating non-linear parameters.

97. The method of Claim 95 wherein the estimating further includes initializing a secondary target response with a primary target response, and adapting the secondary target.

98. The method of Claim 96 wherein the non-linear parameters are selected from a group consisting of mean shifts, residual noise variance, and noise whitening filtering (NWF).

99. The method of Claim 97 wherein the operating on the data further comprises determining a linear error as a function of convolving the primary target response with secondary target taps of the secondary target response.



100. The method of Claim 91 wherein the linear post-processor is matched to the secondary target.

101. The method of Claim 91 wherein the computing the metrics further includes generating revised paths that correspond to each of the at least one most likely error event.

102. The method of Claim 91 further comprising correcting the most likely path based on the selected one of the revised paths.

103. The method of Claim 102 wherein the correcting further includes evaluating a parity condition of the most likely path and correcting the most likely path based on the selected one of the revised paths and the parity condition.

104. The method of Claim 103 wherein the parity condition has a parity violated state and a parity not violated state; and adjusting a correction threshold based on the parity condition such that the correction threshold is set higher for the parity not violated state.

105. The method of Claim 91 wherein the at least one parameter is selected from a group consisting of target length, value of target taps, and quantity of target taps.

106. The method of Claim 91 wherein the Viterbi-like detector is selected from a group consisting of Viterbi detectors, PRML detectors, tree/ trellis detectors, decision feedback detectors and hybrid detectors.

107. The method of Claim 91 included in a receiver to decode a communication signal from a storage device.

108. A method for detecting data in an input signal, comprising:  
equalizing the data to a primary target;  
matching a Viterbi-like detector to the primary target;  
using the Viterbi-like detector to detect data in the input signal;

generating a most likely path corresponding to the data in the input signal;

estimating a secondary target having at least one parameter different than the primary target;

matching a linear post-processor to one of the primary target and a secondary target;

using the linear post-processor to operate on the data and determine at least one most likely error event in the most likely path;

generating revised paths based on the at least one most likely error event;

computing path metrics corresponding to each of the revised paths as a function of the most likely path and the linear response; and

selecting one of the revised paths based on the path metrics.

109. The method of Claim 108 wherein the using the linear post-processor further includes receiving the data from a finite impulse response (FIR) filter.

110. The method of Claim 108 wherein the using the linear post-processor further includes receiving the data from an analog-to-digital converter.

111. The method of Claim 108 wherein the estimating further includes initializing and aligning a secondary target response with a primary target response of the Viterbi-like detector; and adapting the secondary target based on the aligning.

112. The method of Claim 111 wherein the using the linear post-processor further comprises convolving an output of the Viterbi-like detector with secondary target taps of the secondary target response to determine a linear error.

113. The method of Claim 108 wherein the using the linear post-processor further includes generating revised paths that correspond to each of the at least one most likely error event.

114. The method of Claim 108 wherein the using the linear post-processor further comprises correcting the most likely path based on the selected one of the revised paths.

115. The method of Claim 104 wherein the correcting further includes evaluating a parity condition of the most likely path;  
and

correcting the most likely path based on the selected one of the revised paths and the parity condition.

116. The method of Claim 115 wherein the parity condition has a parity violated state and a parity not violated state; and  
adjusting a correction threshold based on the parity condition such that the correction threshold is set higher for the parity not violated state.

117. The method of Claim 108 wherein the at least one parameter is selected from a group consisting of target length, value of the target taps, quantity of target taps.

118. The method of Claim 108 wherein the Viterbi-like detector is selected from a group consisting of Viterbi detectors, PRML detectors, tree/ trellis detectors, decision feedback detectors and hybrid detectors.

119. The method of Claim 108 wherein the linear post-processor is matched to the secondary target; and

wherein the primary target has a target length and the secondary target has a target length that is greater than the target length of the primary target.

120. The method of Claim 118 included in a receiver to decode a communication signal from a storage device.

121. The signal detector of Claim 1 wherein the non-linear noise model is described by the following equation:

$$BM = \ln(\sigma_i^2(x(D))) + \left( \sum_{k=0}^L \hat{f}_k(x(D)) n_{i-k} \right)^2$$

where BM is the non-linear branch metric, L is memory length,

$$\hat{f}_0 = \frac{1}{\sigma(x(D))}, \hat{f}_1 = -f_1 \cdot \frac{1}{\sigma(x(D))}, \dots, \hat{f}_3 = -f_3 \cdot \frac{1}{\sigma(x(D))}, \quad x(D) \text{ represents the}$$

input bits to a channel, and

$$n_t(x(D)) = \sum_{k=1}^L f_k(x(D)) n_{t-k} + \sigma_t(x(D)) N(0,1)$$

122. The signal detector of Claim 31 wherein the non-linear noise model is described by the following equation:

$$BM = \ln(\sigma_t^2(x(D))) + \left( \sum_{k=0}^L \hat{f}_k(x(D)) n_{t-k} \right)^2$$

where BM is the non-linear branch metric, L is memory length,

$$\hat{f}_0 = \frac{1}{\sigma(x(D))}, \hat{f}_1 = -f_1 \cdot \frac{1}{\sigma(x(D))}, \dots, \hat{f}_3 = -f_3 \cdot \frac{1}{\sigma(x(D))}, \quad x(D) \text{ represents the}$$

input bits to a channel, and

$$n_t(x(D)) = \sum_{k=1}^L f_k(x(D)) n_{t-k} + \sigma_t(x(D)) N(0,1)$$

123. The computer program of Claim 61 wherein the non-linear noise model is described by the following equation:

$$BM = \ln(\sigma_t^2(x(D))) + \left( \sum_{k=0}^L \hat{f}_k(x(D)) n_{t-k} \right)^2$$

where BM is the non-linear branch metric, L is memory length,

$$\hat{f}_0 = \frac{1}{\sigma(x(D))}, \hat{f}_1 = -f_1 \cdot \frac{1}{\sigma(x(D))}, \dots, \hat{f}_3 = -f_3 \cdot \frac{1}{\sigma(x(D))}, \quad x(D) \text{ represents the}$$

input bits to a channel, and

$$n_t(x(D)) = \sum_{k=1}^L f_k(x(D)) n_{t-k} + \sigma_t(x(D)) N(0,1)$$

124. The method of Claim 91 wherein the non-linear noise model is described by the following equation:

$$BM = \ln(\sigma_t^2(x(D))) + \left( \sum_{k=0}^L \hat{f}_k(x(D)) n_{t-k} \right)^2$$

where BM is the non-linear branch metric, L is memory length,

$$\hat{f}_0 = \frac{1}{\sigma(x(D))}, \hat{f}_1 = -f_1 \cdot \frac{1}{\sigma(x(D))}, \dots, \hat{f}_3 = -f_3 \cdot \frac{1}{\sigma(x(D))}, \quad x(D) \text{ represents the}$$

input bits to a channel, and

$$n_t(x(D)) = \sum_{k=1}^L f_k(x(D)) n_{t-k} + \sigma_t(x(D)) N(0,1)$$